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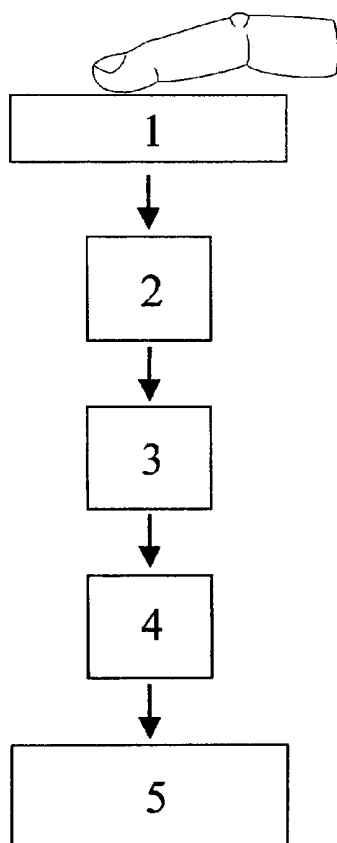
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(54) Title: METHOD AND SYSTEM FOR INPUTTING CHARACTERS



(57) Abstract: Method and system for generating complex text input by sequences of finger touches on a single sign generator in cellular phones including a display and a sign generator, the sign generator including a finger touch sensitive sensor being adapted to sense movements in at least one dimension, analysing means, and translation means, measuring omni-directional finger movements across the sensor in two dimensions, using the analysing means for categorising omni-directional finger movements across the sign generator according to predefined sets of finger movement sequences including directional and touch/no-touch finger movement sequences, using the translating means including uniquely defined command table for translating the categorised finger movements into signals controlling the display as results of the finger movements on the sensor.



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Method and system for inputting characters

This invention relates to a sign/character generator represented by a fingerprint sensor with navigation means,
5 for text/sign input to information and communication devices with displays, like set-top boxes, cellular phones, palmtop PCs, PDAs, etc.

The present information society provides the users with an increasing number of information and communication
10 devices for numerous purposes, and the use of such information and communication devices are expected to accelerate both in types of devices and the number of users of the respective devices.

Most of these information and communication devices
15 contains, or give access to privileged and/or sensitive information. This accentuates the need for access control by identity verification of the user. This has traditionally been handled by passwords or PIN codes. However, these are not personal as they can be given to other persons by the
20 owner, or stolen from the owner. Accordingly there is a strong trend to base access control on biometrics which is mathematical description of characteristic elements of the owner's body or behaviour that can not be separated from this person, and which describes him uniquely. Many forms of
25 biometrics for identity verification is available, but the dominating type of biometrics appear to be fingerprints as it uniquely defines the person, is easy to scan and is not feel to intrude the user's privacy. Hence many types of fingerprint sensors have been made. One such fingerprint
30 sensor is described in EP 735.502.

Implementation of such sensors in information and communication devices on an industrial scale with large volumes is in most cases pending the benefits established through a cost versus benefit analysis. It is also in many
35 cases a question of available space on the device. The utilisation of such identity verification devices as e.g. fingerprint sensors will therefore be significantly enhanced if it can be combined with other functionality, and

especially if it thereby can replace other devices. These two aspects will be illustrated for some typical information and communication devices below.

Cellular phones normally contain a reduced keyboard, typically as shown in fig. 1. Such reduced keyboards have far less keys than the letters, characters and signs required to input complex text messages. This is partly resolved by assigning several characters to each key, as illustrated in fig. 1. However, even with a multiple character representation on such reduced keyboards, the number of keys are so limited that it poses a significant constrain on available characters/signs that can be represented on such reduced keyboard.

Some solutions have been introduced, but they generally do not provide sufficient cost/benefit ratio and functionality to effectively penetrate the market. One example is a full QWERTY keyboard provided by the cellular phone manufacturer Ericsson. However, this external keyboard is large and expensive and counteracts the general trend to make cellular phones increasingly more compact, lighter and cheaper.

Another known solution is the Nokia Naviroller™ in which a mechanical barrel on the front panel is rolled by the finger, bringing up a vertical column of signs and characters on the display. Selection of a particular sign or character is performed by mechanically pressing down the barrel. In practice this is not a faster solution than moving the finger from key to key and pressing the selected key one or multiple times. The Naviroller™ solution also imposes a serious constrain on cursor movements as it limits cursor control to one dimension; <up> and <down>, except for pressing the barrel for character selection.

Tegic Communications has developed a system called T9™ whereby software logic search for legal letter combinations of a particular language, thereby minimising the multiple presses of any key representing multiple characters, as shown in fig. 1. This is an elegant solution as the number of finger taps is presumably significantly reduced, but the negative aspect is that it requires a translation program

for each language, and that these must be stored in the phone memory. Motorola is said to have developed a similar solution, called iTap™, thus having the same problems.

Sign handling of another known type is the Zi 8™
5 provided by ZiCorp, to facilitate character input by Chinese signs through a reduced keyboard as per fig. 1. The Zi 8™ solution is based on the fact that Chinese signs are composed of so-called basic strokes, which sequence defines a particular sign. These basic strokes are assigned to the
10 keys, much in a similar way as the letters are assigned to the number keys, as shown in fig. 1. This solution enables input of Chinese characters by a regular cellular phone keyboard, as per fig. 1, but does not resolve the main problems of using a keyboard for sign/character input to a
15 cellular phone. A keyboard is still required, and due to size limitations it normally contains far less keys than the characters/signs required to compose a meaningful message. The finger therefore has to be moved around the keyboard, and each key may need to be pressed down mechanically
20 multiple times to select a message.

US 5,982,303 describes a joystick to feed characters, numbers and function categories into a processor. The method according to this publication may be use to write non-latin signs and to control a cursor. The publication
25 mentions the use of eight keys for providing the control signals and represents a large and complicated solution. A similar solution is described in US 4,680,577.

It is an object of this invention to provide a simple solution for feeding information into a small unit, e.g. a
30 cellular phone, by using sensors which have already been provided for other purposes.

US 5,088,070 describes the use of several dedicated switches on a wrist watch. Although it is more compact than the abovementioned solution it still represents an
35 unnecessary large structure on the limited available space.

US 6,057,540 describes an optical sensor with navigation utilities. It's dimensions and complexity, however, makes unsuitable for usse in mobile phones and similar. Also, as the sensor described here preferably uses

a 16x16 pixel matrix it is not suitable for use as a fingerprint sensor, since the resolution is insufficient.

US 5,608,395 describes a telegraph key connected to a computer for writing text. The characters are organized in a hierarchy for demanding a minimum memory for choosing each character. This solution is also too complicated and large and does not have the advantage of using existing sensors in mobile phones or similar.

The above illustrates the present situation for information/communication devices (such as cellular phones), where complex text input is cumbersome as such input has to be generated through the limited keyboard of fig. 1. The next generation of cellular phones comprises so-called WAP phones with Internet access. In general this development calls for increased displays, for better readability of more complex information. Preferably increased display size should not increase the cell phone size. The most viable way to increase display size without increasing the phone size will be to reduce the keyboard size to maximum one row of keys, but still enabling complex text input to the cellular phone. None of the above solutions will function satisfactorily with such a minimal "keyboard", as illustrated in fig.2.

Identical problems are encountered for small handheld PCs (so-called palmtops) and for PDAs. Also for these devices it is a general desire to increase the display size, without increasing the overall dimensions of the device. This can only be achieved by using minimum keyboard size. Various solutions have been implemented to eliminate the keyboard, but they are all associated with serious negative effects. One solution is to provide the palmtop or PDA with a touch-screen, but such screens are more expensive than regular displays. Another known solution is to provide the palmtop or PDA with a special pen to write on the screen. However, such pens are expensive, they may easily be lost, and they generally require that writing is done according to predefined sequences of sign elements that must be drawn within fairly narrow boundaries of shape.

Similar problems are also encountered for set-top boxes

for television sets connected to cable TV for pay-per-view applications. For such set-top boxes the TV screen may be used as communication interface (e.g. for search for information and ordering of films) but this requires a keyboard.

5 Such an extra keyboard for the TV increases the costs, and represents yet another external device that normally clashes with the design of the TV, and needs to be stored nearby the TV. The ideal solution would be to have a single-button keyboard incorporated in the set-top box, which may be used
10 both for input of complex text and for identity verification, e.g. if minors shall be barred from ordering X-rated movies, etc.

Similar problems are also encountered for automobiles increasingly being equipped with computers for navigation
15 purposes, for selection of entertainment, etc. Such applications require communication interface between the driver and the on-board computer. In a car the use of a keyboard is not tempting as its use will distract the driver's attention from the traffic situation, and may be
20 hazardous. Apparently voice control could be an elegant solution, but this seems to be impractical due to the general noise level in a car. It will also require implementation of voice commands in many languages, as most car models are made for the international market, thereby
25 requiring extensive memory capacity in the onboard computer, which in turn adds logistics requirements and costs.

For laptop PCs the problem is different, as they normally have integrated full-fledged QWERTY keyboard. As one of their primary functions is to enable fast and complex
30 text input, replacing the keyboard with single-button text input device would be counterproductive. However, such laptops are normally furnished with a cursor navigation control in the form of a touch-pad. It is highly desirable to provide these laptops with fingerprint sensor for access
35 control, both for securing sensitive information contents and to discourage theft of such expensive devices. In this context it will be desirable to combine such a touch-pad and fingerprint sensor, if technically possible, for cost and space reasons.

Thus it is an objective of this invention to provide a sign generator for information and communication devices equipped with a display, as outlined above. Such sign generator shall be capable of generating complex text input
5 in a fast and convenient way through a single-button "keyboard". It shall further be able to execute accurate cursor control on the display providing full touch-pad functionality, and shall incorporate fingerprint scanning for authentication. This objective is obtained by a sign
10 generator based on combining a fingerprint sensor having navigation means, with analysing/interpreting means and translation means as described in claims 1 and 9.

The invention will be described below by way of examples and with reference to the accompanying drawings.
15 Figure 1 illustrates a traditional reduced keyboard for cellular phones, with multi-character keys.

Figure 2 illustrates schematically an information/-communication device, equipped with a large display and a single sign-generator key as part of a minimum "keyboard".

20 Figure 3 illustrates the invention schematically.

Figure 4 illustrates categories of finger movements in two dimensions.

Figure 5 illustrates how to operate text input by selecting characters on the display, by finger commands.

25 Figure 6 illustrates the stroke hierarchy for Chinese signs, and the representation of reduced strokes on a small keyboard.

Figure 7 tabulates stroke/sign hierarchy of Chinese signs.

30 Figure 8 illustrates how to operate in calculation mode by finger commands on a palmtop PC.

Figure 9 illustrates a typical example of embodiment in set-top boxes.

35 Figure 10 illustrates a typical example of embodiment in automobiles.

First the principle of the invention will be described, followed by description of some typical applications. The principle of the invention is illustrated schematically in fig. 3. A touch sensitive switch 1, in the form of a

fingerprint sensor with navigation means, is coupled to analysing means 2. The analysing means measures the duration, direction and speed of finger moves on the switch, and categorises the signal from the switch into categories.

5 The classified categories of data are stored in a memory 3 and are compared by a translation means 4 with predefined tables relating categories of finger moves and sequences thereof to readable characters/signs. The signs corresponding to these categories and sequences are then

10 shown in the display 5 in a known manner. The form in which the data are presented on the screen, and how text input is interacted by the user is controlled by the translation means 4.

The touch sensitive switch 1 may in its simplest form

15 be a simple on/off touch sensitive switch. In this case the system will register the duration of the finger touches, as well as the disconnection periods in order to distinguish between periods between the signals, periods between complete characters/signs and periods between words.

20 The connection categories may be selected by measuring the connection period t_m and comparing them t_{moff} with predefined limits according to defined sets of finger commands. The system comprises lower and upper limits for being registered as a signal. Signals being shorter than the

25 lowest limit defined as t_{reg} may be ignored to avoid errors caused by accidental touches of the switch 1 e.g. due to handling of the information/communication device. Connection periods longer than the predefined limits may also be ignored, or may be classified as a separate code, for

30 example "End of message". In addition long disconnects may be registered as periods between signs. Table 1 defines typical time limits.

Table 1

Time Ranges	Nom. Values	Meaning	Type
$0,001s < t_{Reg} < 0,100s$	$t_{Reg} = 0,01s$	Reg. limit	Basic/Non-adapt
$1,5 t_{Reg} < t_{Off} < 50,0 t_{Reg}$	$t_{Off} = 0,25s$	Sign Sep.	Adaptive
$1,5 t_{Reg} < t_{Short} < 50,0 t_{Reg}$	$t_{Short} = 0,25s$	Dot	Adaptive
$1,5 t_{Short} < t_{Long} < 5,0 t_{Short}$	$t_{Long} = 0,50s$	Dash	Adaptive
$1,5 t_{Long} < t_{Extra} < 10,0 t_{Long}$	$t_{Extra} > 0,75s$	Period	Adaptive

The time limits of Table 1 above may of course be chosen otherwise. A particular embodiment of the invention is to set the above ranges dynamically to adapt to the user's skills and his learning curve in using the invention. This may be done by registering the e.g. 50 last commands of each type, and calculating the arithmetic mean and standard deviation. The statistics may be based upon any written text or a predetermined learning sequence, and may be used to shift the category definitions according to the speed of the user, and thus also adapt as the user learns the system and increases his input speed.

The touch-sensitive switch 1 may in its simplest form be a simple on and off touch sensitive switch. However, this is insufficient relative to the objective of the invention to provide combined user authentication by finger print biometrics, accurate cursor control and fast, versatile and flexible text input, all served by the very same single-button sensor. The preferred embodiment of the invention must therefore provide a fingerprint sensor with navigation means where the switch is also capable of registering lateral finger movements on the switch. A known sensor is described in EP 735.502, which describes a line shaped fingerprint sensor. The fingerprint sensor described in this patent publication scans the fingerprint, and in order to be able to analyse the finger print, is able to detect the finger movement across the sensor in one dimension; <Up> and <Down>. Such one-dimensional finger movement detection may be expanded to two-dimensional finger registering by arranging some of the sensor elements as per fig. 4. This may for example be obtained by using two orthogonal sensors of the type shown in the EP publication mentioned above. The

figure illustrates categories of lateral finger movements that are used to build finger commands, either by basic finger moves, or combinations thereof. Fig. 4 defines ten lateral finger movement categories (in addition to vertical taps); eight directions of movements and two circular movements (clockwise and counter-clockwise). These may also be combined with time measurements to calculate the velocity of a movement, thus providing a number of differing categories from one single finger movement. All the finger movements (on/off sensor, vertical taps, lateral linear and circular movements), their duration and speed are categorised in the analysing/interpretation means 2.

Such a touch-sensitive switch comprising a finger print sensor with navigation means enables the invention to use comprehensive and intuitive sets of finger commands in the interpretation/translation means 4. Combined finger commands can be made from sequences of basic finger movements.

As the touch-sensitive switch will serve multiple purposes in a combined function, as per the objective of the invention above, a finger command structure is required that is applicable to all functions to be served, including versatility of the input modes. Moreover the finger command structure must be intuitive within each mode, to avoid the need for memorising complex finger commands. Such a finger command structure is exemplified in Table 2 below. This finger command structure is a key element of the invention, and represents a basic element of the translation means.

The analysing means can be set by finger commands to alternative modes, where the default is Display Mode, another may be Sign-based language input (e.g. Chinese signs), etc. The Input Modes are shown schematically in fig. 4.

10

Table 2 Finger Command Structure

Display Mode Commands			
Vertical Screen Input Commands		Horizontal Screen Input Commands	
(One-character wide vertical Selection Fields)		(One-line high Command Fields or Option Fields)	
5	Select Character	<Double Tap>	Select Command/option
10	One position down	<Finger Down>	One line down <Finger Down>
	Scroll down One position up	<Finger Down - Hold>	Scroll down One line up <Finger Up>
	Scroll up	<Finger Up - Hold>	Scroll up <Finger Up - Hold>
Screen Manipulation Commands			
15	Toggle to horizontal fields	<Slanted Down Left>	Shift vertical fields <Finger Right/Left>
20	Toggle to vertical fields	<Slanted Up Right>	Shift horizontal fields <Finger Up/Down>
	Toggle to/from Edit Text Mode	<Extra Long Tap> - <Finger Down>	

Edit Text Commands				
5	Home of Text Field	<Slanted Up Left>	Toggle to/from Edit Mode	See Screen Manip. Commands
	End of Text Field	<Slanted Down Right>	Mark <i>n</i> characters left	<Long Tap> + <i>n</i> <Short Taps>
	Move one position left	<Finger Left>	Mark <i>n</i> words left	<Long Tap> + <i>n</i> <Finger Left>
	Scroll left	<Finger Left - Hold>	Shift marked letters' case	<Long Tap>
10	Move one position right	<Finger Right>	Delete marked character(s)	<Extra Long Tap>
	Scroll right	<Finger Right - Hold>	Copy marked character(s)	<Double Tap>
	One line up	<Finger Up>	Paste marked character(s)	Two <Double Taps>
15	Scroll up	<Finger Up - Hold>	Insert space right of cursor	<Short Tap>
	One line down	<Finger Down>	Write to right of cursor	Exit Edit to Input Mode
	Scroll down	<Finger Down - Hold>		

Global Commands		Sign Language Commands	
20	Shift Input Mode	<Circular Finger Move>	<Circular Finger Move> brings up Command Field w/ Sign Language Mode. <Double Tap> to select. Then use <Finger Down/Up> for Chinese, Japanese or Korean signs
	Toggle Edit Text	See Screen Commands	
	End of Text Input	Two <Extra Long Tap>	

This embodiment of the invention, comprising a single-button input device for multiple input modes uses "universally defined" finger command structures embedded in the translation means, ensuring that the sign generator provides the required input type in the respective input modes of the information/communication devices. The input modes are arranged in a hierarchy. Level 1 is shown in Table 3a. This is the overall mode level, where input mode alternative is set by the information/communication device. There is a fourth mode in addition to the three modes shown in Table 3a, namely Sleep Mode for minimum power consumption while sensor do not need to be active.

Table 3a

MODE LEVEL 1

Automatically set by the Device

ACCESS CONTROL MODE	TEXT INPUT MODES	CURSOR CONTROL MODE
Fingerprint sensor used for User Authentication	See Table 3b "Mode Level 2"	For cursor navigation on display

Table 3b

MODE LEVEL 2

User selected by Finger Commands from Text Input Modes

Input Categories				
		Alphabetic Languages	Sign- based Languages	Special Operations
Input Device	On Display by Finger Commands	Latin alphabet Greek alphabet Arabic	Chinese Japanese Korean	Mathematics
	Draw on Sensor directly	NA	Chinese Japanese Korean	Alternative codes

The Finger Movement Categories defined in Table 1 combined with the sensor element configuration as per fig. 4 and the Finger Command Structure per Table 2 and the Input

Modes & Categories as per Tables 3a & 3b allows full versatility and flexibility of input by a single-button multi-function device.

The utilisation of this functionality of the single-button sensor will be demonstrated by two examples of text input generation; generating text input by Latin letters by the display, controlled by Finger Commands and generating text input by Chinese signs by drawing basic strokes directly on the sensor. These examples will be followed by description of the invention used for some typical applications.

The first example comprises text input by Latin letters to e.g. a cellular phone with a large display and a minimum keyboard, as shown in fig. 2. The cellular phone will switch the single-button sign-generator system to the text input mode (Level 1 in Table 3a) as response to user selection of e.g. SMS (Short Message System). Thereby the translation means 4 arranges the display 5 typically as shown in fig. 5a comprising vertical selection field 8 and horizontal command field 9. The user may conveniently shift between the vertical and horizontal fields by finger commands <Slanted Down Left> and <Slanted Up Right> 10, as per the embedded Finger Command Structure in the translation means 4. In this example the user will use Latin letters and Arab numbers for the text input. This is the default text input mode, and the user does therefore not need to shift to the horizontal command field for change of input mode, but he can directly start generating text by finger commands to the vertical selection field 8. Fig. 5b illustrates a number of alternative character sets of the selection field in this mode. When he starts generating text the default set is capital Latin letters, displaying letter A in the marked middle position of the vertical selection field. Say the user first wants to input an E as the first character. He then moves his finger down and keeps it still on the switch 1. This starts scrolling the vertical selection field. When the character E has been brought to the marked middle position the user <Double Taps> on the switch, selecting the required letter E and displaying it in the display 5. This

14

selection automatically switches the character set of the vertical selection field to minor letters. The user then wipes his finger up or down over the sensor, according to the position in the alphabet of the next required character.

5 If he wants to move a single character, or just a few characters, he moves his finger once or several times up or down. If the next character is a larger number of positions away, he moves his finger in the desired direction and then holds the finger still on the switch to start scrolling in
10 the desired direction. The scrolling halts when he lifts his finger from the switch 1. If the user needs other character sets, he simply gives finger commands 14 <Finger Left> or <Finger Right>, e.g. to insert numbers, special characters or to use capital letters again (e.g. for a name). Word
15 separation may be done by finger command <Long Tap> and period ("punctum") may be entered as two consecutive <Long Taps>, etc. The user may at any time toggle to Edit Text Mode by finger command sequence <Extra long Tap> - <Finger Down> as per Table 2. End of Message may be given by finger
20 command sequence comprising two consecutive <Extra Long Taps>.

Prior to this text input (when the cellular phone is switched ON) the cellular phone has automatically set the switch 1 to authentication mode for access control to the
25 cellular phone. The user is then asked by text on the display to wipe his finger down over the sensor. When authentication by finger print biometrics is completed, the cellular phone sets the sign-generator to sleep mode, for energy saving. The sign-generator is then waked up e.g. when
30 a request for the sign-generator is called for, e.g. by SMS input as per above. If the user wants to play a game on the cellular phone its control system sets the switch 1 to Cursor Control Mode as per Table 3a. Two-dimensional finger moves combined with combined finger command sequences (such
35 as taps, etc.) thereby gives an accurate cursor control combined with numerous command functions for quite complex games. This example demonstrates that the invention is capable of rendering full input versatility and flexibility even through a single-button sign-generator, thereby

enabling the use of a large display as exemplified in fig. 2 still maintaining full functionality.

The next example of this embodiment of the invention, demonstrates text input by Chinese signs on a cellular
5 phone. Each sign of a sign-based language like e.g. Chinese is composed of strokes (and components thereof). Although there are hundreds of thousands of signs in such a language, it is possible to enter such signs by a QWERTY keyboard, because individual strokes can be assigned to the various
10 keys and each sign is composed of a strict sequence of strokes. As more signs are entered in a certain sequence the resulting optional signs are gradually limited until finally the wanted sign is uniquely defined. ZiCorp has taken this approach one step further by their Zi 8™ method. It consists
15 of a new level of so-called reduced strokes that represents the 29 basic strokes by 8 reduced strokes. These eight reduced strokes of Zi 8™ can thereby be represented by the limited keys of a reduced keyboard, similar to how the alphabetic letters are represented on such a keyboard in
20 fig. 1. The corresponding representation of the Zi 8™ reduced strokes on such a reduced keyboard is shown in fig. 6b, while fig. 6a shows the hierarchy of reduced strokes, basic strokes, components and finally Chinese signs. As seen from fig. 6a the hierarchy comprises 4 or 3 levels, pending
25 if components are considered as an independent level or not. By the Zi 8™ method it is therefore possible to generate Chinese signs from a reduced keyboard as per fig. 6b, but it is even more cumbersome than entering a alphabet-based text by multiple key presses (per fig. 2, simply because the
30 hierarchy in a sign-based language comprises more levels. An elegant solution to resolve this problem by another preferred embodiment of the invention is to use the single-button sign-generator method by using the touch-sensitive switch 1 combined with finger commands and a Finger Command
35 Structure embedded in the translation means 4. The invention can be used in two input modes for generating e.g. Chinese signs; either by stroke selection from vertical selection fields on the display, or by directly drawing the components on the sensor switch 1 with two-dimensional registering of

finger movements. The latter requires that the categories and sequences of finger moves comprising a particular stroke or component is embedded in the Finger Command Structure of the translation means.

5 Sign input by manipulating the selection fields on the display by finger commands will be described with reference to fig. 5. When the user has set the cellular phone to text input mode (e.g. by SMS) the display is organised as per fig. 5a now being in the default Latin alphabet mode. In
10 order to switch to Chinese sign mode, the user gives the finger command <Slanted Down Left> 10 to shift from the vertical selection field 8 to the horizontal command field 10. The command field will display "Latin alphabet" as the default. The user enters the finger command <Circular Finger
15 Move> 11 by moving his finger in a circle (clockwise or counter-clockwise) on the switch 1. This brings up other input modes (e.g. "Mathematics", etc.) in the command field, until eventually the wanted choice "Sign-based Languages" appears. The user then enters the finger command <Double
20 Tap> 12 on the switch 1, confirming he wants the sign-based mode. By finger command <Finger Down> 13 he can step through the alternative sign-based languages (e.g. Japanese, Korean) until he hits Chinese. He then <Double Taps> 12 to confirm his selection. By this selection setting the translation
25 means will rearrange the alternative character sets of this mode. For instance the default set may contain the reduced Zi 8™ strokes. By selecting one such stroke by <Double Tap> the content of the vertical selection field shifts to the character set representing the basic strokes corresponding to
30 the selected basic stroke. The user then proceeds to select the wanted basic stroke, or gives finger command <Finger Left> or <Finger Right> to display the corresponding component set. Thereby the same hierarchy is maintained in sign composition as per fig. 6a. A more convenient
35 embodiment of the invention does, however, comprise 8 character sets each representing the basic strokes, as per the table of fig. 7. The character set grouping is thereby done according to the structure of the Zi 8™ reduced strokes, and the user therefore can skip one level in the

hierarchy.

The preferred embodiment of the invention for this mode (sign-based language text) will, however, be to draw the Zi 8™ reduced strokes directly on the sensor. The required
5 finger movement categories, and their sequence for combined movements needs to be embedded in the finger command structure of the translation means. A further enhancement will be to embed the required finger commands for all the 29 basic strokes directly in the finger command structure, to
10 skip one level of the hierarchy of fig. 6a. When the number of basic strokes, and their sequence, has limited the alternative Chinese signs corresponding to this stroke sequence to some extent, the candidate signs may be displayed in an option field placed horizontally over the
15 command field 9. The most frequently used of the candidate signs should be displayed first. When the user sees the wanted sign in the option field he may switch to this field by finger command 10 <Slanted Down Left> and then move <Finger Right> until wanted sign is marked, and then <Double
20 Tap>. In any case the signs generated by the sign-generator system above may then be given to a language program of ZiCorp or similar to provide a functional package for sign-based languages. This embodiment of the invention simply represents an alternative method of inputting such strokes
25 or components to complete language programs, as alternative to keyboard such as illustrated in fig. 6b.

Accordingly this embodiment of the invention enables generating even complex text composed from Chinese signs by a single sign-generator button. It is therefore possible to
30 shrink reduced keyboard sets, as per fig. 1, to a single sign-generator switch, as per fig. 2, without losing functionality in generating complex text messages, and with vastly improved speed and convenience. The above examples were described for use with cellular phones, but is equally
35 applicable to palmtop PCs and PDAs.

Fig. 8 illustrates another input mode that the Finger Command Structure of the translation means 4 can accommodate. This example pertains to mathematical calculation on a palmtop PC, but may as well be embodied in

cellular phones or PDAs. For such calculations the applicable Finger Command Structure set will be limited to taps on multiple selection fields as per Table 1, while lateral finger movements is reserved for cursor control.

5 Fig. 8a illustrates a palmtop PC set to Calculation Mode (arithmetic) in which mode the display 5 contains another type of vertical selection field 16 and another horizontal selection field 17. The vertical selection field 16 contains all numbers from 0 to 9, plus decimal point (,) as
10 illustrated in fig. 8b. The horizontal selection field 17 comprises in this mode the arithmetic operators (+, -, * , /) plus Clear All (C_{All}), Clear Memory (M_{Clear}), add to memory (M^+), subtract from memory (M^-), square root ($\sqrt{}$) and n^{th} power (n), etc as illustrated in fig. 8c. In this mode the lateral
15 finger commands are mainly reserved for cursor control. This means that when the finger is moved laterally over the sensor 1, the cursor moves accordingly on the display 5. An arithmetic formula such as "972 * 3 = ?" is generated on the display by moving the cursor over number "9" in the vertical
20 selection field 16 and <Double Tap> for selection, cursor is then moved to "7" and selected, the cursor then moved to "2" and selected. The cursor is then moved by lateral finger command to the "*" sign of the horizontal field and selected by <Double Tap>, then back to the vertical selection field
25 16 over number "3" and selected by <Double Tap>. The user then presses <Extra Long Tap> which produces "=" on the display, starts the calculation and presents the result "2.916" in the display. Other character subsets of the vertical selection field 16 may be incorporated. Navigation
30 by fingerprints inside the selection fields may be initiated by finger command <Short Tap> when cursor is positioned within the vertical selection field to temporarily disengage the cursor control by finger commands. Then the user may shift character sets of the vertical selection field 16 by
35 <Finger Left> or <Finger Right> commands (as per fig. 5b). When the new character set has been activated the cursor control by lateral finger commands on the switch 1 can be re-engaged by pressing another <Short Tap>. Similarly the horizontal selection field may be changed to other subsets

of mathematical operators by placing the cursor in the horizontal selection field, pressing <Short Tap> to disengage the cursor control, use finger commands <Finger Up> or <Finger Down> to select other subsets, and finally press
5 <Short Tap> to re-engage the cursor control by lateral finger commands. This embodiment of the invention enables a versatile and flexible calculation mode on the display, still operated by a single-button switch 1.

By the embodiment of the invention described above for
10 cellular phones, palmtop PCs and PDAs, the combined fingerprint sensor with navigation means, and interpretation/-analysing means to identify finger commands on the sensor and a finger command structure embedded in the translation means, enables the use of a single-button keypad to enter
15 complex text via the display in a convenient and versatile way. The same sensor is also used for finger scanning for access control by user authentication to protect personal and privileged information on the device. The invention thereby enables a cost-efficient solution with a large
20 display and a minimum keyboard, yet enhancing the versatility for the user.

Further application of the invention is illustrated by another embodiment of the invention for set-top boxes for television sets for pay-TV, etc. For this embodiment the
25 invention using a combined fingerprint sensor with touch-pad functionality enables identity verification of the user. By enrolling the fingerprints of the family, minors can be prevented from ordering X-rated movies, etc. At the same time the combined fingerprint sensor and cursor control
30 enable complex communication via the TV screen, by the use of a minimum keypad, eliminating the need to hook up a full-fledged QWERTY keyboard to the TV. This embodiment of the invention is illustrated in Fig. 9. The set-top box 18 may contain an On/Off button 19, two function keys (Accept/-
35 Reject) 20 and 21, and the switch 1 with navigation means. By finger commands on the switch 1 the user may position the cursor in dedicated communication fields on the TV screen 22. The communication fields may comprise; search for titles, order selection, user profile of family members

(access to X-rated movies or not) and similar for other services. The Finger Commands for this application may be a significantly reduced instruction set, as compared to the comprehensive Finger Command Structure exemplified in Table 2. The analysing/interpretation and translation means of fig. 3 may be embedded in a chip integrated in the set-top box 18.

Yet another embodiment of the invention is for Driver's interaction with the onboard computer in a car, as illustrated in fig. 10. The combined fingerprint sensor/navigation means will act as an intelligent key preventing anybody than the authorised and enrolled users to ignite the engine, as theft protection. This application requires encryption of the sensor communication with the onboard computer and its engine control, to prevent by-pass by hackers/thieves. The sensor 1 may be located on the steering wheel 23 or on the gear stick knob 25, as per fig. 10. In addition to access control the sensor with navigation means may be used by the driver to communicate with the onboard computer, for GPS navigation display, for audio system control etc. Circular finger motions (clockwise and counter-clockwise) according to the Finger Command Structure of Table 2 may change mode, e.g. from ignition (access control) to GPS navigation control and audio system control. When selecting audio system control, <finger.up> and <finger down> movements may change radio channels, switch between tracks on CDs, etc. If two sensors 1 are mounted on the steering wheel 23, the left sensor may be used for entertainment (audio systems, etc.) while the right switch may be used for gear shift, where upward finger strokes represent gearshift upwards, and downwards finger strokes represent gearshift downwards. The finger commands on the switch 1 will be the driver's input device to the onboard computer while the interface will be presented on a display 24 mounted in the car's dashboard. The display 24 shall preferably be menu-driven for convenient operation in a hierarchy of functions, as indicated by a typical opening screen of the dashboard display 24.

Yet another embodiment of the invention is for Laptop

PCs, not illustrated by any figure. For this application the need to eliminate the keyboard is not a prioritised issue, as a full-fledged QWERTY keyboard provides higher input speed than a single button input key, and keyboard input is the main input form to laptop PCs. However, laptop PCs normally comprises a touch-pad to eliminate the need for an external mouse. Also laptop PC producers are looking for fingerprint biometrics for access control user authentication by biometrics to protect any privileged and sensitive information that the laptop may comprise. Instead of incorporating both a touch-pad and a fingerprint sensor, the fingerprint sensor with navigation means according to the invention will combine both functions into one single switch.

The invention thus uses a fingerprint sensor as touch-sensitive switch 1 that has the ability to register finger connections on the sensor and the duration of such touches, as well as lateral finger movements and their directions and type of movement. Such a sensor with navigation means as described above is supplemented with sets of finger movement categories and sequences thereof in the interpretation/-analysing means 2. This is combined with sets of Finger Command Structures (as per Table 2) embedded in the translation means 4.

This preferred embodiment of the invention enables a multi-function single-button input key which combines several functions;

- Fingerprint scanning for user authentication for access control.
- A powerful text input device where sets of extensive finger commands supports convenient and fast input of complex text/signs/characters in a versatile and flexible manner for text input of alphabetic languages and sign-based languages, as well as enabling input to special operations like calculations etc.
- The sensor's registration of lateral finger movements enable accurate cursor control either as part of text input sequences via the display, or for stand-alone cursor control through a single-button input device for

multiple functionality, thereby integrating touch-pad functionality in the single device.

Thereby the invention enables reduction of the device's traditional keyboard as per fig. 1 towards devices with a large display and a minimum keyboard as per fig.2 without
5 losing versatility and flexibility even with complex inputs.

The invention also eliminates the need for large keyboards for input to/interfaces with set-top boxes and
10 for onboard computers in automobiles. The compact sensor may be fitted in small spaces, e.g. on the knob of the gear-stick in a car, etc.

C l a i m s

1. Method for generating complex text input by sequences of finger touches on a single sign generator in cellular phones including a display and a sign generator, the sign generator including a finger touch sensitive sensor being adapted to sense movements in at least one dimension, analysing means, and translation means, .

measuring omni-directional finger movements across the sensor in two dimensions,

using the analysing means for categorising omni-directional finger movements across the sign generator according to predefined sets of finger movement sequences including directional and touch/no-touch finger movement sequences,

using the translating means including uniquely defined command table for translating the categorised finger movements into signals controlling the display as results of the finger movements on the sensor.

2. Method according to claim 1, wherein the sensor is sensitive to movements in two dimensions.

3. Method according to claim 1, wherein the categories are ordered in a hierarchy, a first categorised finger movement thus selecting a first set of signs, the second categorised movement selecting a sign or subgroup from the first set of signs.

4. Method according to claim 3, wherein the hierarchy has at least three levels.

5. Method according to claim 4, wherein the categories define a Chinese sign set.

6. Method according to claim 2, wherein the finger movements control cursor movements on the display within the selected table of characters, signs or commands.

7. Method according to claim 6, wherein at least one finger movement controls the selection of the desired character, sign or command which the cursor has been moved to within the selected table.

8. Method according to claim 1, wherein at least two of the categorised movements is related to a control signal for the display, said display indicating at least one list of signs and said control signal indicating scrolling and choosing in said list or lists.

9. Sensor system comprising fingerprint scanner sensor with the ability to detect finger touches as well as lateral finger movements, storing means containing predetermined categories of finger movements and sequences thereof and sets of finger command structures, enabling a multi-function tool for fingerprint scanning, text/character input in multiple modes, and cursor control, all by finger commands on a single sensor.

Fig. 3

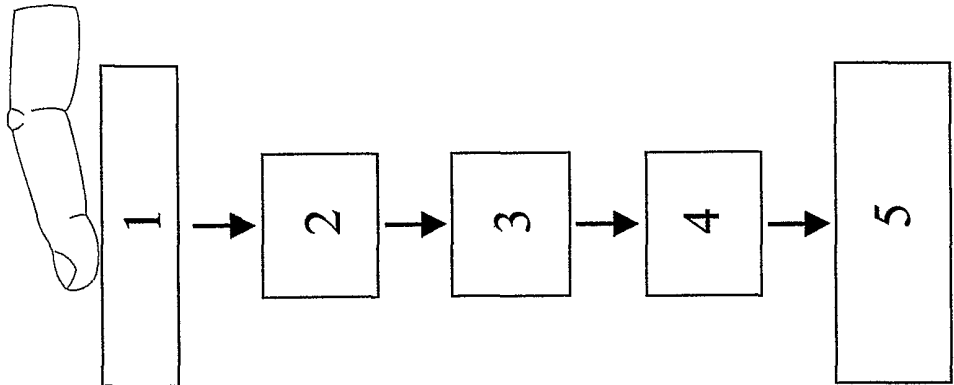


Fig. 2

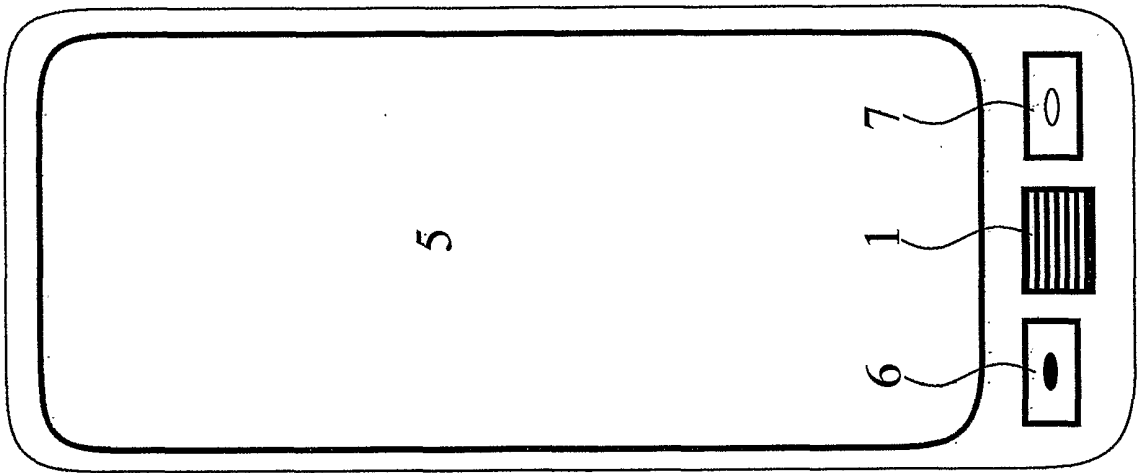


Fig. 1

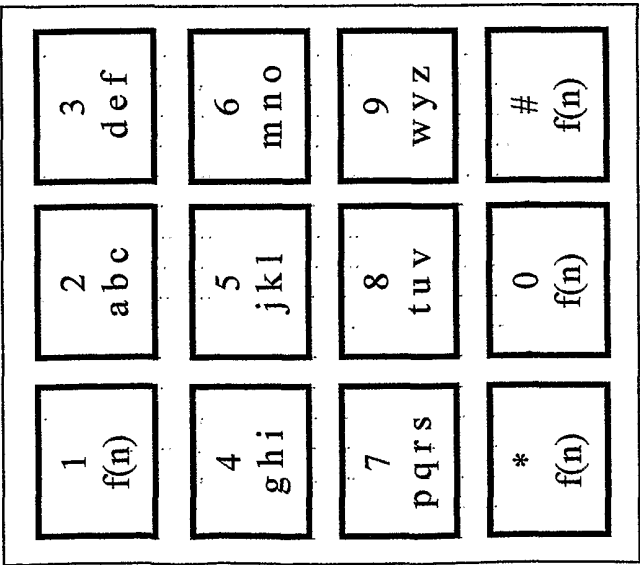


Fig. 4

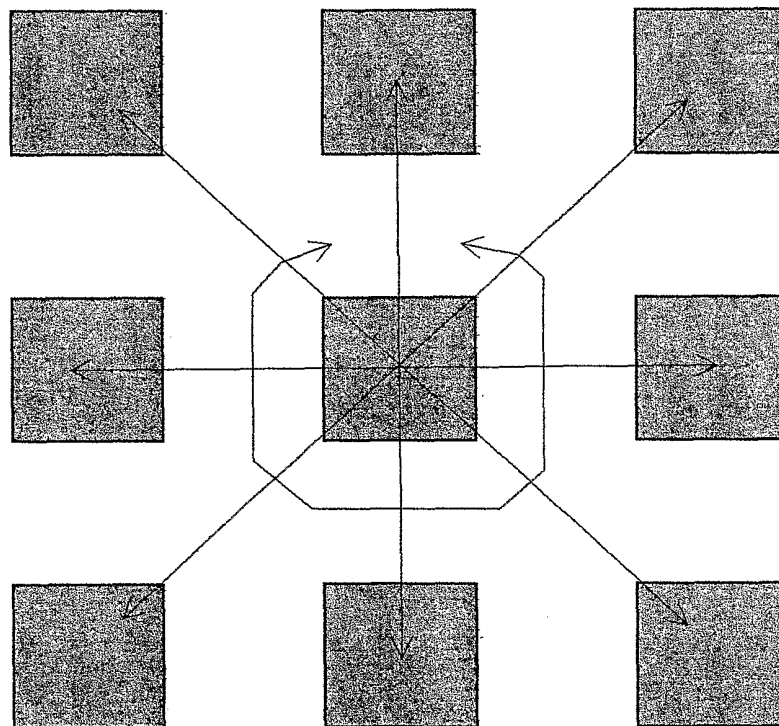


Fig. 5

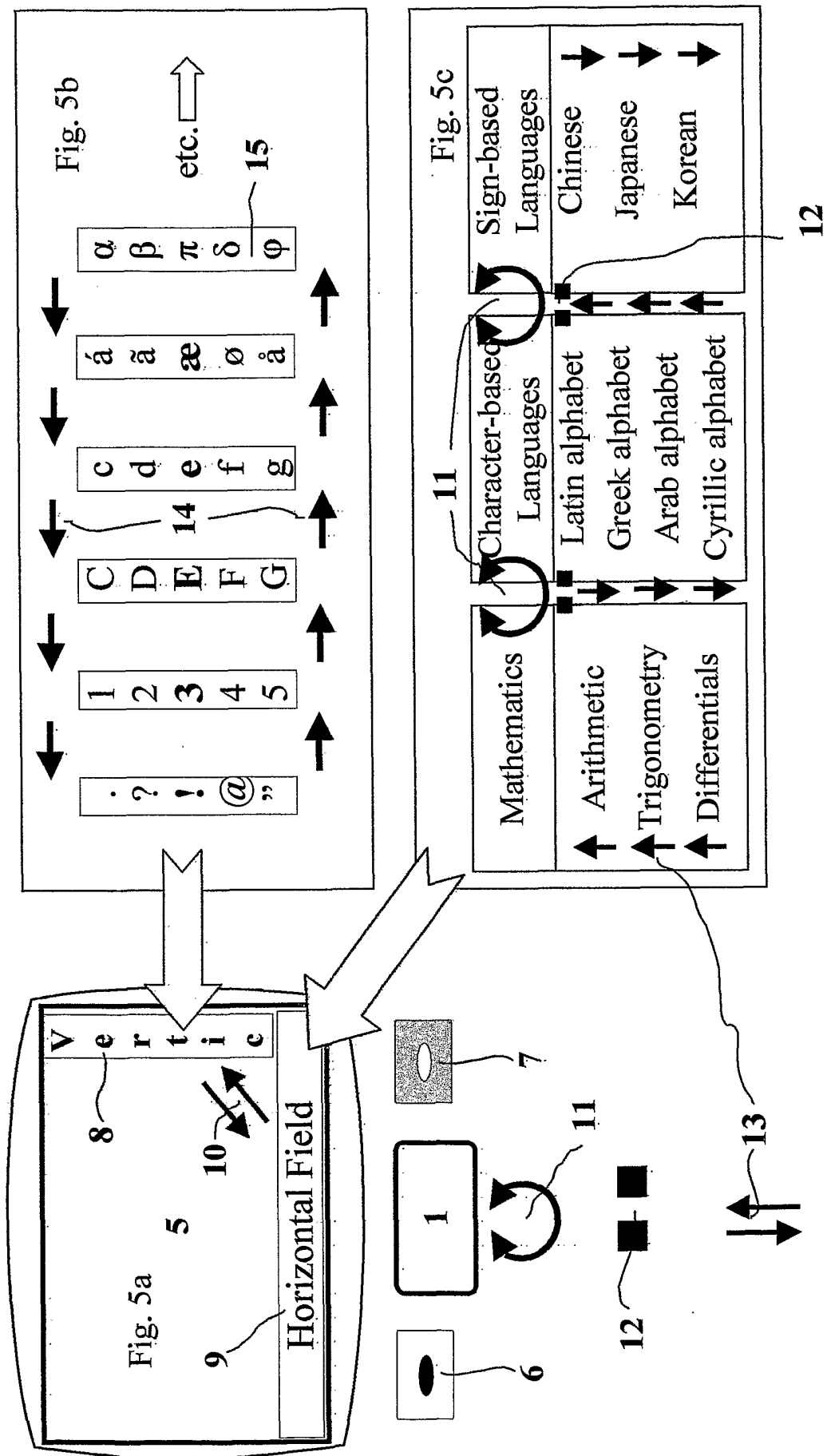


Fig. 6a

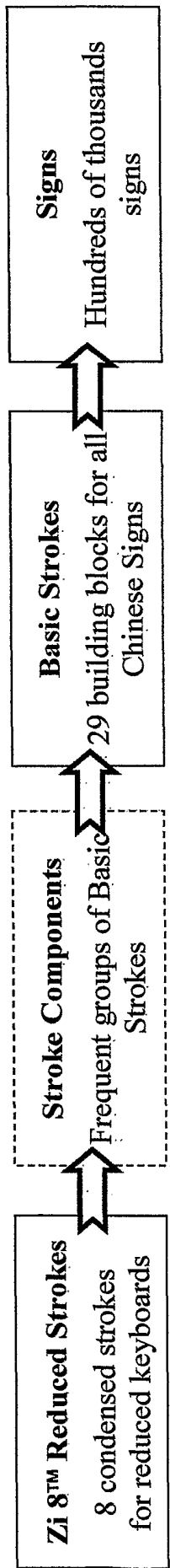


Fig. 6b

1 Left Slope	2 Over	3 Dot
4 Down - Over	5 Down	6 Over - Hook
7 Curved Hook	8 *	9 Over - Down - Hook
* Wild Card Key	0 - more - More Key	# f(n)

Fig. 7

Keypad Location	Zi 8™ Stroke	Basic Stroke	Stroke Name	Characters
1	ノ	ノ	Left Slope	人 休 竹
2	一	一	Over Lift	王 十 在 大 紅 刁
3	丶	丶	Dot Right Slope	六 学 州 人 八 火
4	ㄥ	ㄥ	Down - Over Left Slope - Over Left Slope - Dot Down Hook Right Slope - Hook Over - Hook Down - Over Down Over - Hook Down Over - Left Slope Down Over - Down Hook Down Over - Down	山 巨 屯 去 鈞 能 女 巡 樂 衣 以 如 戎 或 氏 心 必 氏 四 西 巳 色 毛 去 上 張 馬 上 張 鼎 上 張
5	丨	丨	Down Down - Hook	中 止 打 小 水 打
6	ㄣ	ㄣ	Over - Hook Over - Down Over - Down - Hook Over - Left Slope Over - Down - Over - Left Slope Over - Down - Curved Hook Over - Down - Over - Down - Hook	耳 干 皮 口 巳 户 包 力 羽 又 之 社 及 牙 社 从 牙 社 乃 切 社
7	ㄣ	ㄣ	Curved Hook	事 狗 狗
8	Wild Card Key	*	Undefined strokes	
9	ㄣ	ㄣ	Over - Down - Hook Over - Down - Over Over - Down - Lift	飞 九 风 投 船 回 箭 计 认
0	More Key	etc., etc.	More optional characters	

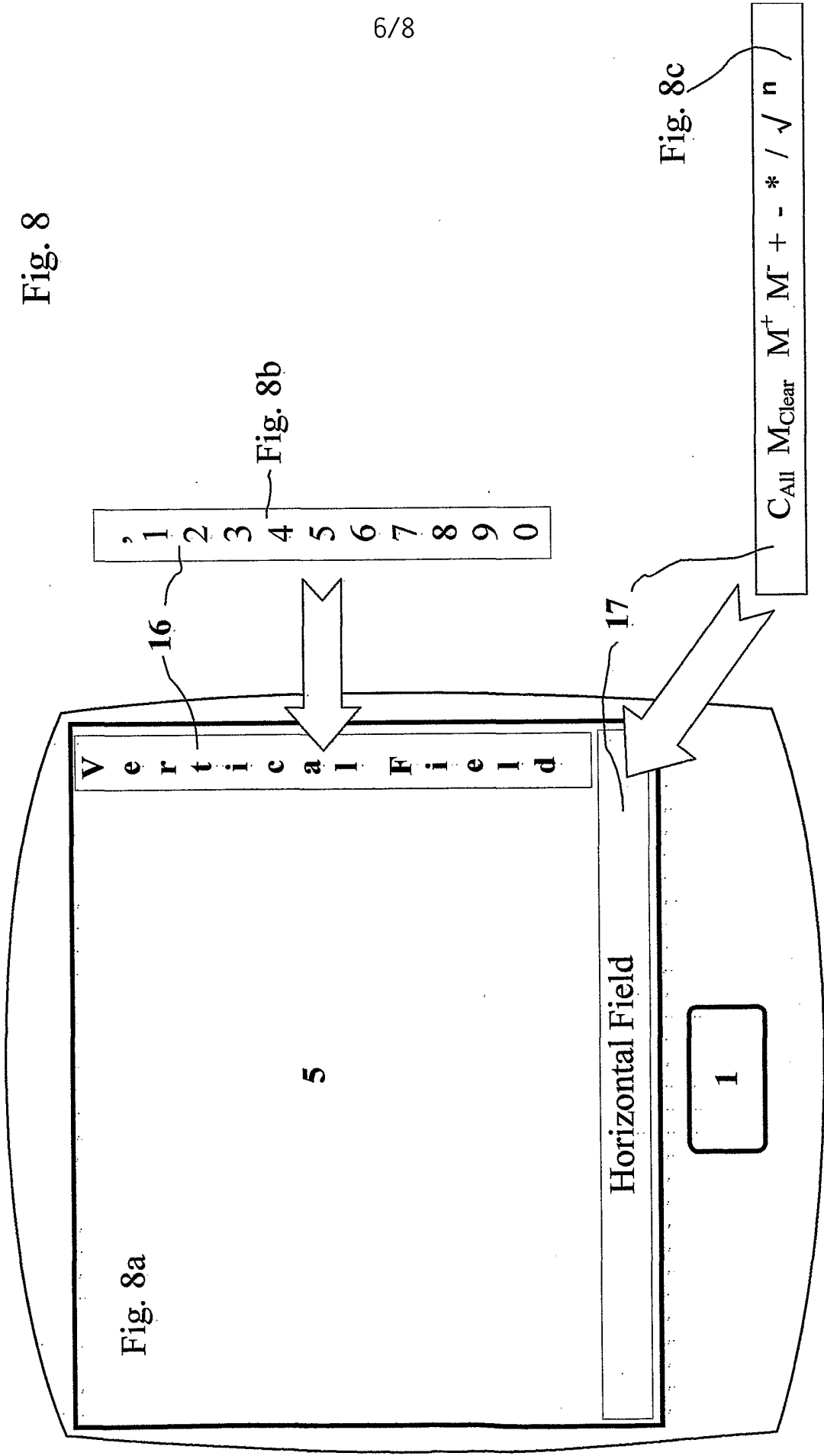


Fig. 9

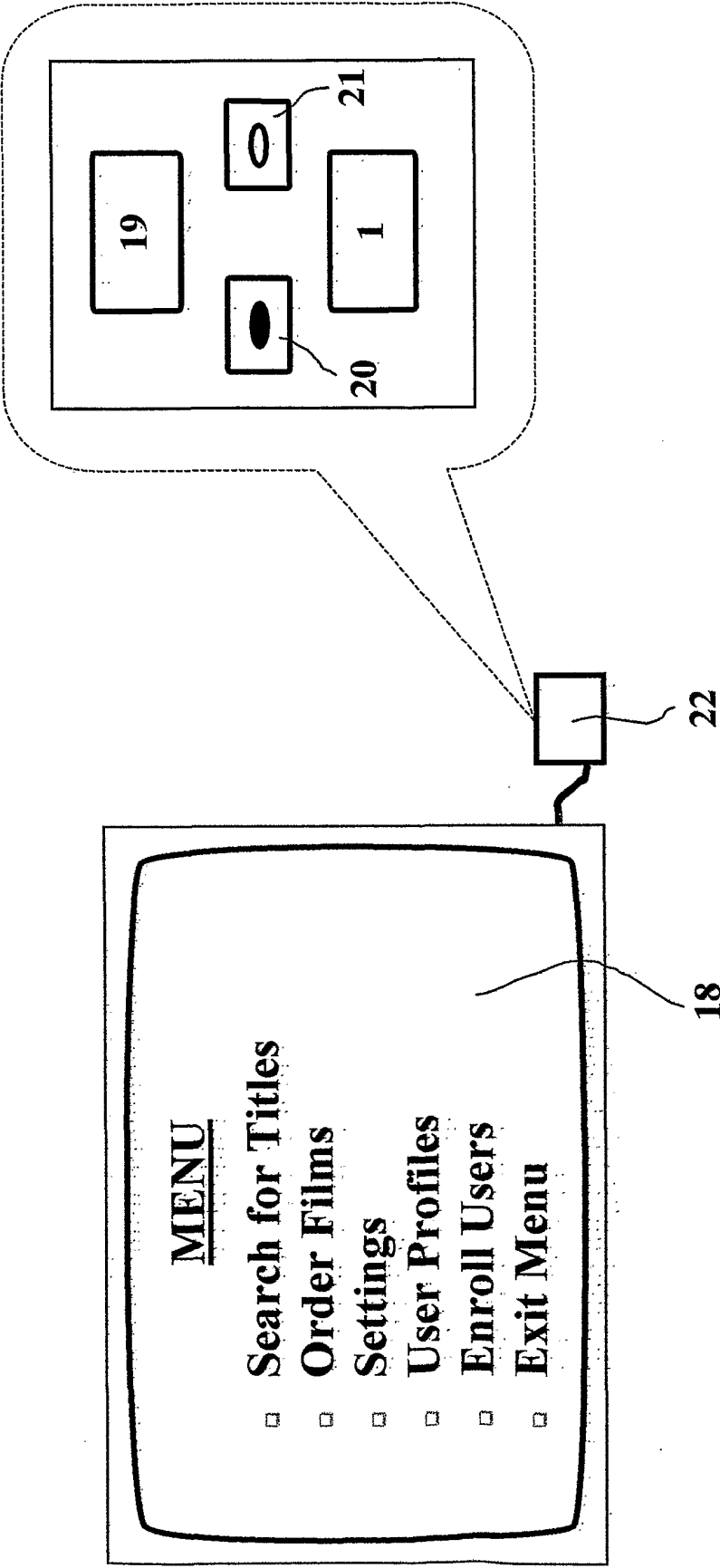
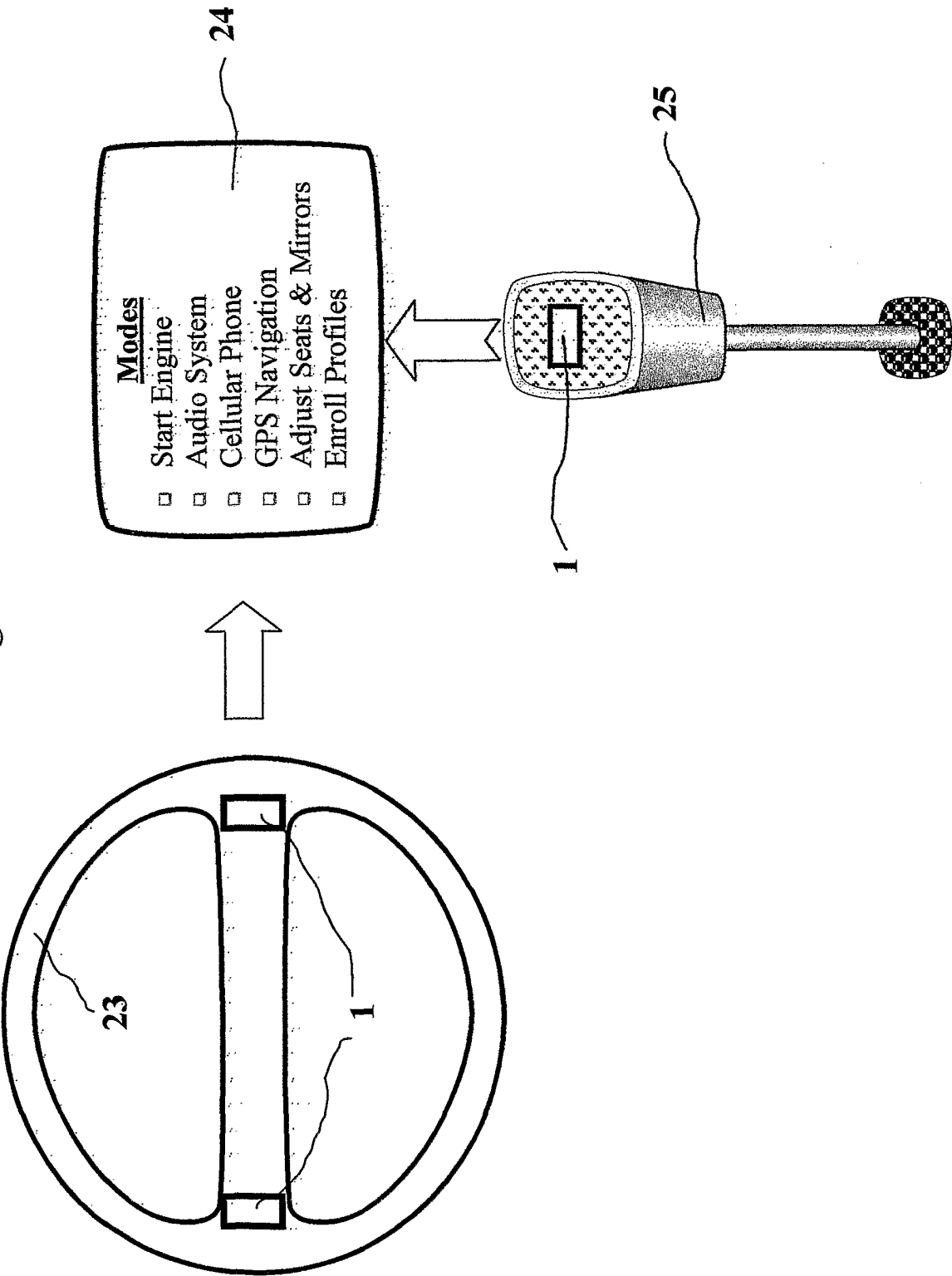


Fig. 10



INTERNATIONAL SEARCH REPORT

International application No.

PCT/NO 01/00384

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04M 1/247, G06F 3/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: G06F, G06K, H04B, H04M, H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5608395 A (KURTZ ET AL), 4 March 1997 (04.03.97), column 2, line 9 - column 7, line 12, figures 1-2, abstract --	1-9
Y	US 6057540 A (GORDON ET AL), 2 May 2000 (02.05.00), column 2, line 57 - column 9, line 67, figures 1-2, abstract --	1-9
Y	EP 0973123 A1 (LUCENT TECHNOLOGIES INC), 19 January 2000 (19.01.00), column 1, line 25 - column 5, line 50, figures 1-3, abstract --	1-9

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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Date of the actual completion of the international search

31 January 2002

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/NO 01/00384

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	EP 0924948 A1 (SIEMENS AKTIENGESELLSCHAFT), 23 June 1999 (23.06.99), column 1, line 46 - column 2, line 42, figure 1, abstract --	1-9
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Y	EP 0927949 A2 (SAMSUNG ELEKTRONICS CO LTD), 7 July 1999 (07.07.99), column 1, line 53 - column 10, line 53, figures 1-5B, abstract --	1-9
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/NO 01/00384

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DE	19528734	A1	05/02/97	NONE		
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